



Development Prospects of Apple Farming in India

Ripin^{a++}, Khushi Khandelwal^{a++}, Muskan Gupta^{a++},
Saket Mishra^{b#}, Shashi Kant Ekka^{b†*}, Reena Kujur^{c†}
and Johnson Lakra^{c#}

^a Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India.

^b Department of Biological Science, SHUATS, Prayagraj, Uttar Pradesh, India.

^c College of Agriculture and Research Station, Kunkuri, Chhattisgarh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAAR/2024/v24i1483

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/112057>

Review Article

Received: 19/11/2023
Accepted: 24/01/2024
Published: 27/01/2024

ABSTRACT

The cultivation of apples in India has observed significant growth and transformation over the years, becoming a crucial component of the country's horticultural landscape. This review provides a comprehensive analysis of the current state of apple production in India, highlighting key factors influencing its cultivation, challenges faced by growers, and the economic impact on the agricultural sector. The review begins by exploring the historical evolution of apple cultivation in India, tracing its origins and the introduction of different apple varieties. It examines the geographical distribution of apple orchards across the country, emphasizing the diverse agro-climatic zones that contribute to the cultivation of this temperate fruit.

⁺⁺ M.Sc. Student;

[#] Assistant Professor;

[†] Research Scholar;

*Corresponding author: Email: shashiekka441@gmail.com;

Keywords: Apple cultivation; varieties; distribution; challenges.

1. INTRODUCTION

Apples are a popular fruit in India, as it opted third place in popularity of fresh fruits [1]. Apple farming are professionally done in Himalayan region of our country. It is suitably grown in subtropical and temperate regions. The states of Himachal Pradesh, Jammu and Kashmir and Uttarakhand are the major apple-producing regions in India [2]. A range of cultivation methods are used to grow apples, including contemporary high-density plantings and traditional orchards [3]. Apple trees are established in traditional orchards with a spacing of approximately 6 metres by 6 metres. The trees are trained to grow on fences or held up by poles. In high-density plantings, a method known as "super spindle" is used to train trees to grow straight and much closer collectively [4]. This is economically beneficial for the production of higher number of trees under a small area and results in higher yields (vedwan, [5] and Kumar et al.,[6].

Additionally to being farmed for the fresh fruit market, apples are also utilised in the manufacturing of a range of value-added goods, such as apple juice, apple sauce, and dried apples. These goods are well-liked both domestically and abroad, and a sizable portion of India's apple harvest is exported (Yue & Beghin, [7] and naqash et al., [8].

2. APPLE PRODUCING STATES IN INDIA

2.1 Jammu and Kashmir

It is the major contributor for apple production in India, 77.71% of the nation's total production is produced by the state. Hartta, [9].The annual production of apples in Jammu and Kashmir is estimated to be 1808.33 tonnes. Apple growth is facilitated by the state's ideal temperature and rich soil, which contribute to the high level of production. Many farmers and rural communities in the state rely on the apple business for employment and money, which plays a significant role in the local economy.

2.2 Himachal Pradesh

It is popularly known as the apple state of India, accounting for 19.19% of global apple production. Several apple cultivars, such as Rich-e-Red, Mollies, Gala, and Anna, are well-known in the state. A range of farming methods

are used to raise these apples, including high-density modern plantings and conventional orchards. Many farmers and rural communities in Himachal Pradesh receive work and revenue from the apple industry, which makes a significant contribution to the local economy [10].

2.3 Uttrakhand

Approximately 2.52% of India's apple crop is produced in this state, making it a substantial contribution to the country's apple production. Additionally, the government is trying to enhance the methods used in the Dehradun region to produce apples. 58.66 tonnes of apples were produced in Uttarakhand the year before. For farmers and rural people in Uttarakhand, the apple business is a significant contributor to the local economy, offering both employment and revenue prospects. Negi & anand, [11].

2.4 Arunachal Pradesh

Attributing 0.32% of the nation's total apple production, it is one of the leading apple-producing states in India. The state ranked third among Indian apple-producing states in terms of quantity, having produced 7.35 tonnes of apples the year prior. In Arunachal Pradesh, the apple business plays a significant role in the local economy by giving farmers and rural populations jobs and a source of income [12].

3. POPULAR APPLE VARIETIES

3.1 Red Delicious

This apple variety, which is considered traditional in India, has a vibrant red exterior and luscious, sweet flesh. Its slightly elongated shape makes it a popular choice for both fresh eating and apple sauce preparation.

3.2 Golden Delicious

This apple is crisp and delicious with a yellow or golden peel. Because of its adaptability and capacity to maintain its shape when baked, it is frequently used in cooking and pie making. It is a popular option for eating fresh as well and has a circular, tapering shape.

3.3 Granny Smith

This apple has a sour flavour and is green in colour. Because of its firm flesh and capacity to maintain its shape when baked, it is frequently

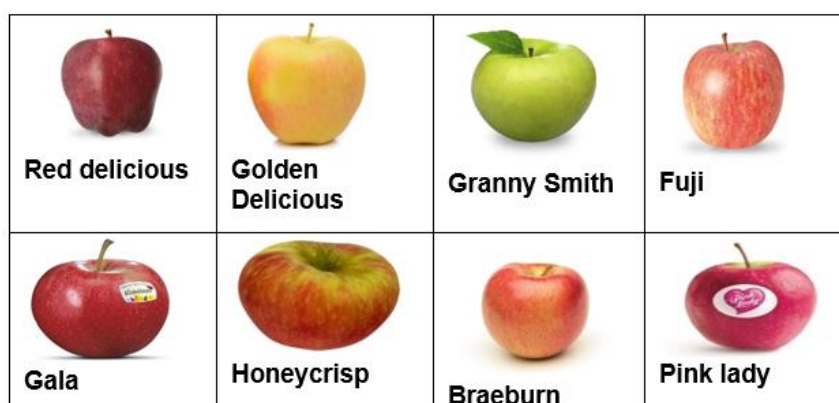


Fig. 1. Different varieties of apple

used for cooking and pie-making. It is a popular option for fresh dining and has a circular shape.

3.4 Fuji

This apple is juicy and sweet, with skin that is both red and yellow. Because of its crisp texture and sweet flavour, it is a favourite choice for fresh eating. Its circular, tapering shape makes it useful for baking and cooking as well.

3.5 Gala

This is a crusty, delicious apple with red and yellow skin. It has a round and tapering shape. Its solid meat and sweet flavour make it useful in baking and cooking as well.

3.6 Honeycrisp

This apple has a reddish-yellow hue and is juicy and tasty. It is a popular option for eating fresh and has a circular, tapering shape. Its solid flesh and sweet flavour make it a useful ingredient in baking and cookery.

3.7 Braeburn

This is a crisp, delicious apple with red and yellow skin. It is well-liked for eating fresh and has a rounded, tapering shape. Its solid meat and sweet flavour make it useful in baking and cooking as well.

3.8 Pink Lady

This apple is crisp and sweet with a peel that is pinkish-red. It's a popular option for eating fresh and has a circular, tapering shape. Because of its solid flesh and sweet flavour, it's also utilised in baking and cooking.

4. SUITABLE CLIMATE FOR APPLE PRODUCTION

An agricultural product suitable for a moderate climate is the apple. However, the regions of India that grow apples do not lie in a temperate zone; rather, the region's temperate temperature is a result of the Himalayan peaks and high elevations. (Rai *et al.*, [13] and Ahmed *et al.*, 2021). During the active growing stage, the summertime average temperature should be between 21 and 24 °C. Apple grows best in areas where trees have a restful winter and plenty of sunshine for healthy colour development. A height of 1500–2700 metres above sea level is suitable for its growth. The ideal growing conditions for apple trees are evenly spaced rainfall between 1000 and 1250 mm during the growing season.

5. PROPAGATION METHOD OF APPLE

5.1 Rootstocks

Rootstocks are the base and roots of grafted fruit trees (Fig. 2). Apples are mostly grown by grafting or budding on wild crab apple seedlings. Another option is to use the seedling rootstocks made from the seeds of diploid cultivars such as Granny Smith, Macintosh, Yellow Newton, Golden Delicious, and Wealthy [14]. High density planting is done using dwarfing rootstocks such as M9, M4, M7 and M106.

5.2 Budding

Shield budding is the primary method of propagating apples and yields a high success rate. Shield budding involves making a 'T' shaped incision (Fig.3) beneath the rootstock's peel to implant a single bud and a shield piece of



Fig. 2. Apple rootstock preparation



Fig. 3. T-Budding of apple

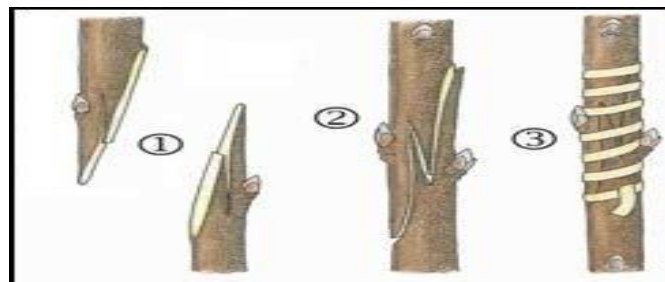


Fig. 4. Whip and tongue grafting

stem during the active growth period. When the summertime buds are fully formed, budding takes place. In the Kashmir Valley, the Kumaon hills of Uttaranchal, the high hills of Himachal Pradesh, and the mid-hills of Himachal Pradesh, September is the best month for blossoming.

5.3 Grafting

There are multiple ways to propagate apples, including clefting, whipping, tongue, and root grafting which can be observed in Fig.4. Best outcomes are obtained with tongue and cleft grafting between February and March, at a distance of 10-15 cm above the collar. Grafting is often completed by the end of winter.

6. PLANTING TECHNIQUE OF APPLE TREE

The planting technique differs according to variety and the richness level of soil. For planting trees usually one pollinator tree is required for two to three large trees planted at distance of 10 meter. The pollinator tree is planted after every sixth tree in a row for high density planting.

On an average of 200 – 1250 number of plants can be planted in one hectare area. There are four diverse categories of planting density that are –i) low, in which less than 250 plants/ha. Can be grown, ii) moderate which having capacity of 250-500 plants/ha., iii) high, in which upto 500-

1250 plants/ha. and ultra-high density has the capacity of more than 1250 plants /ha.

6.1 Irrigation

Low soil moisture can severely affect apple trees. During the growing season, water stress decreases the quantity and size of fruits and increases June drop. When it comes to the success of apples, a year-round even distribution of rain is crucial, especially during the key seasons when dry spells occur. It is necessary to give additional irrigation. Usually in the months of December and January, the orchards receive their first irrigation just after manuring. The crop is irrigated every seven to ten days throughout the warm months. The crop is irrigated once a week after the fruit setting stage. The colour of the fruit is significantly improved by applying water during the two weeks before harvest. After then, irrigation is administered every three to four weeks till the start of dormancy.

6.2 Manure and Fertilizer

Along with other fertilizers, farmyard manure is applied at a rate of 10 kg per year of apple tree age. The amount of organic manure put to the crop and the soil's fertility determine how much fertiliser is needed. For fully grown bearing trees,

split dosages of 350 g N, 175 g P₂O₅, and 350 g K₂O should be applied per plant each year. Zinc, boron, manganese, and calcium deficiencies can be seen on some trees, but these can be fixed by applying the right chemicals by foliage spraying.

6.3 Harvesting

With the exception of the Nilgiris, where the season runs from April to July, apples are typically available for harvest in September or October. Depending on the type cultivated, the fruits reach maturity 130–150 days after reaching full bloom. Fruits change colour, texture, and quality as they mature, and their distinctive flavour develops during this time. When the fruits are harvested, they should be crisp, firm, and uniform. Depending on the type, the skin's colour at maturity can range from yellow to red. However, the ideal time to harvest depends on the quality of the fruit and how long it will be stored. Hand picking is advised now that dwarf rootstock has been introduced, as it minimises bruises from falling fruit during mechanical harvesting [15].

A well-managed apple orchard yields on an average 10-20 kg/tree/year (Bourke *et al.*, 2009). The apple tree starts bearing fruit from fourth year onwards.

Table 1. The major constituents of apple fruits per 100g are as below

Elements	Amount (g)	Elements	Amount (mg)	Elements	Amount (mg)
Water	85.46	Calcium	6.0	Iron	0.12
Protein	0.25	Phosphorous	11.0	Potassium	106
Fat	0.16	Thiamin	0.016	Magnesium	5.0
Sugar	10.38	Riboflavin	0.025	Folate (µg)	3.0
Dietary fibre	2.40	Niacin	0.090	Carotene (µg)	26.0
Carbohydrate	13.80	Vitamin C	4.60	Energy(kcal)	51.0

(Source -USDA 2019-20)

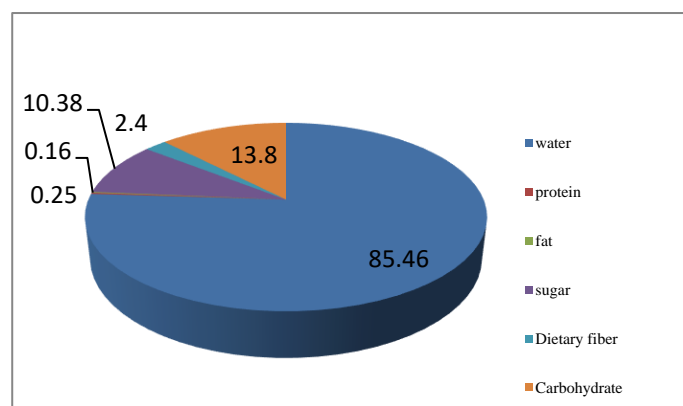


Fig. 5. Major elements per 100g

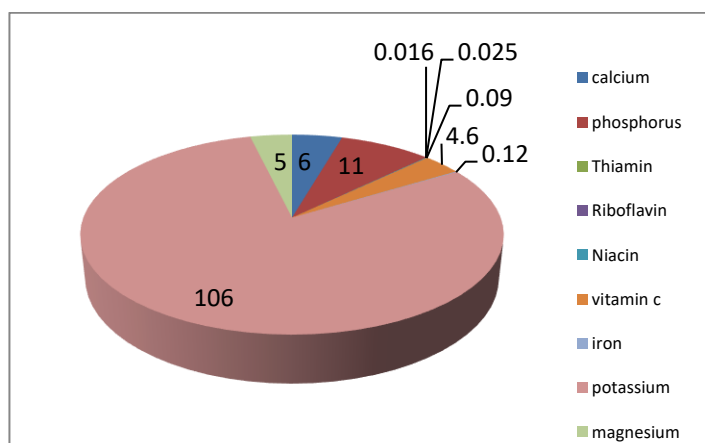


Fig. 6. Minor elements per 100mg

7. LITERATURE REVIEW

Various studies have been done to evaluate diverse aspects of apple farming in the state of India, incorporating the varied aspects which includes current status [16], spatio-temporal dynamism [17], cost-benefit analysis [18], marketing efficiency [19], recent environmental problems (Rana et al.,2011), qualitative SWOT analysis [20] etc.

The climate-induced changes in apple farming practices have also influenced the life and livelihood of the farmers. The apple orchards grown northward is certainly an outcome of increasing temperature as the region has experienced an increase of 0.5°C temperature from 2000 to 2014 Sahu et al [21]. The farmers cultivating apple have also encountered several physical, socio-economic, and policy-oriented limitations [19].

8. HEALTH BENEFITS OF APPLE

Consuming apples had found to be very beneficial for health perspectives. Eating apples can stimulates gums, and their flavour increases spit flow, which reduces tooth decay by reducing the amount of microscopic organisms in the mouth. For dwarf rootstock apples, hand picking is advised because it lessens bruises from falling fruit during mechanical harvesting. Chaudhary et al., [22].

Quercetin, an anti-cancer substance found in apples, is especially concentrated in red delicious apples. This anti-cancer drug facilitates the safe assembly of the body's natural defences. Quercetin is a type of cell

reinforcement found in red apples. Boyer et al.,[23]

Consuming apples and pears has also been demonstrated to assist middle-aged Brazilian women who are overweight in losing weight. David et al.,[24].

9. CHALLENGES FACED IN APPLE FARMING

- **Climate change-** It is causing a severe challenge for apple cultivators. Increasing temperature causes pest attacks and risk of diseases. The unpredictable weather events such as early rains, hailstorms, drought and frost can damage the apple crops leading to yield reduction and also affects the farmers income [25].
- **Unseasonal snowfall** - Snowfall during the harvest season can damage the apple crop, affecting its quantity and quality of fruit [26]. This can lead to financial losses to those farmers, whom were primarily depend on apple cultivation as a source of income.
- **Lack of credit and insurance** - Many farmers do not have access to insurance, which can protect them from unconditional risks. One of the main reasons for the lack of insurance is the high premiums charged by insurance companies. Due to which Farmers face several risks, including weather-related risks, pests, and diseases, which can lead to significant financial losses.
- **Pest attacks-** Pest attacks can have a significant impact on apple yields and lead to significant financial losses for

farmers. The damage caused by pests can reduce the quality of the apples. Pests such as codling moth, apple scab, and mites can significantly damage apple crops.

- **High input costs-** For the initial production of apple it requires a huge expense for its fertilizers, pesticides, and other inputs which makes a challenging factor for small farmers. One of the main cause for the high input costs is the inadequacy of inputs in the cultivation region.
- **Market access-** Market access is a significant problem for apple cultivators in the Kashmir valley. The lack of proper market infrastructure, limited market access, and traders' involvement make it difficult for farmers to sell their product at reasonable prices. The lack of proper storage facilities, transport infrastructure, and processing units results in a lot of wastage and spoilage of the produce [27-30].

10. CONCLUSIONS

The growth of both traditional and fresher assortments has been a beneficial development for Apple development in India. Particular parts of India have seen an increase in the growth of the apple industry due to government backing and the emphasis on improving planting board standards. Still, it is advised to refer to later sources or rural reports from prominent Indian professionals for the most remarkable and explicit data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Shah ZA, Dar MA, Dar EA, Obianefo CA, Bhat AH, Ali MT, Sayed S. Sustainable fruit growing: An analysis of differences in apple productivity in the Indian state of Jammu and Kashmir. *Sustainability*. 2022;14(21):14544.
2. Islam RT, Shrivastava S. Trends in area, production and productivity of apple producing states of INDIA. *Indian Journal of Social Research*. 2018;59(1).
3. Wani FA, Songara M. Status and position of apple crop in area, production and productivity in himachal pradesh. *International Journal of Multidisciplinary Research and Development*. 2018;5(11): 106-111.
4. Mika A. Trends in fruit tree training and pruning systems in Europe. In *I International Symposium on Training and Pruning of Fruit Trees*. 1991;322:29-36.
5. Vedwan N. Apple growers' associations in northwesternindia: emergence, success, and limitations in the context of state-society interactions. *human organization*. 2008;67(1):86-96.
6. Kumar A, Ram S, Bist LD, Singh CP. High density orcharding in fruit crops: A Review. *Annals of the Romanian Society for Cell Biology*. 2021;25(6):948-962.
7. Yue C, Beghin JC. Tariff equivalent and forgone trade effects of prohibitive technical barriers to trade. *American Journal of Agricultural Economics*. 2009;91(4):930-941.
8. Naqash F, Wani SA, Mir SA, Wani WM, Baba SH, Malik HA. Economics of pesticide use in the apple producing areas of kashmir valley. *International Journal of Advance Research and Innovative Ideas in Education*. 2019;5(4):68-80.
9. Hartta YS. Apple production and productivity in himachal pradesh: a study of shimla and kinnour districts. *Journal Transformation of Knowledge*. 2023;1(2).
10. Balakrishna S. *Case studies in marketing*. Pearson Education India; 2011.
11. Negi S, Anand N. Supply chain of fruits & vegetables agribusiness in uttarakhand (india): major issues and challenges. *Journal of Supply Chain Management Systems*. 2015;4(1):43-57.
12. Moyong O, Saroh V, Pertin M. Socio-economic development of tribal society in arunachalpradesh: a study on the role of orange cultivation. *excel international Journal of Multidisciplinary Management Studies*. 2013;3(4):40-54.
13. Rai R, Joshi S, Roy S, Singh O, Samir M, Chandra A. Implications of changing climate on productivity of temperate fruit crops with special reference to apple. *Journal of Horticulture*. 2013;2(2):135-141.
14. Marini RP, Fazio G. Apple rootstocks: history, physiology, management, and breeding. *Horticultural Reviews*. 2018;45: 197-312.
15. Board NIIR. *Cultivation of fruits, vegetables and floriculture*. NIIR Project Consultancy Services; 2005.

16. Wani FA, Songara M. Status and position of apple crop in area, production, and productivity in Himachal Pradesh. *International Journal of Multidisciplinary Research and Development*. 2018;5(11): 106-111.
17. Negi CM. Dynamics of apple production in Himachal Pradesh. *Agricultural Situation in India*, LXXVII. 2020;(2):20-30.
18. Sharma I, Randev AK, Gill JS. Apple cultivation in Kullu district of Himachal Pradesh: A cost analysis. *Asian Journal of Agricultural Extension, Economics & Sociology* 2018;25(4):1-8.
19. Wani FA, Songara M. Production and marketing efficiency of apple farming: A study in Shimla and Kullu districts of Himachal Pradesh. 6thICMR Conference, Hyderabad, India; 2019.
20. Singh N, Sharma PL, Thakur AK, Lodhiyal LS. Apple cultivation in Himachal Pradesh: SWOT analysis and identified issues for the sector development –A case study. *Global Journal of Current Research*. 2015;3(3):68-73.
21. Sahu N, Saini A, Behera SK, Sayama T, Sahu L, Nguyen VTV, Takara K. Why apple orchards are shifting to the higher altitudes of the Himalayas?. *PLoS One*. 2020;15(7):e0235041.
22. Chaudhary dA, Chaudhary mR, Judal aL. Apple: varieties and its health benefits. *Research Journal of Animal Husbandry and Dairy Science*. 2014;5 (1):35-38.
23. Boyer J, Liu RH. Apple phytochemicals and their health benefits. *Nutrition Journal*. 2004;3:1-15.
24. David, M. The slow down diet: Eating for pleasure, energy, and weight loss. Simon and Schuster; 2015.
25. Khorshidi J, Tabatabaei MF, Ahmadi FM. Storage temperature effects on the postharvest quality of apple (*Malus domestica* Borkh. cv. Red Delicious). *New York Science Journal*. 2010;3(3):67-70.
26. Sheikh BA, Baba SH. Problems in Apple Farming: A Case of Kashmir Valley. *International Journal of Agriculture and Animal Production*. 2023;3(03):39-46. (IJAAP) ISSN 2799-0907.
27. Javid, B. Problem of apple marketing in Kashmir. *Commerce and Management*. 2012;1(6), 105-111.
28. Ahmed N, Lone FA, Hussain K, Kanth RH, Sheraz Mahdi S. Impact of climate change on temperate fruit production in Kashmir Valley, North Western Himalayan Region of India–Challenges, Opportunities and Way Forward. *Climate Change and Agriculture in India: Impact and Adaptation*. 2019;251-262.
29. Bourke RM, Gibson J, Quartermain A, Barclay K, Allen B, Kennedy J. Food production, consumption and imports. *Food and Agriculture in Papua New Guinea*. 2009;2:30-144.
30. Rana RS., Bhagat RM, Kalia V. Impact of climate change on apple crop in Himachal Pradesh. *Journal of Agrometeorology*. 2011;13(2):97-103.

© 2024 Ripin et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<https://www.sdiarticle5.com/review-history/112057>